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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of **Akira Okamoto, et al.**

Docket No.: NU-98035

Serial No. 09/198,376

Group Art Unit: 3743

Filed: November 24, 1998

Examiner: A. Flanigan

For: **Thermal Control Device**

Assistant Commissioner of Patents and Trademarks
Washington, D.C. 20231

DECLARATION UNDER 37 C.F.R. §1.132
OF
Yoshimi Kubo

Sir:

I, Yoshimi Kubo, declare as follows:

1. I am a graduate of the Applied Chemistry Department of The University of Tokyo in the year of 1977.

2. I have been an employee of NEC Corporation from 1977 to present. My most recent responsibilities and tasks include:

A: Fundamental Research Laboratories from 1998 to present. My responsibilities and tasks included the material development of thermal control device for spacecraft. The development for one particular thermal control device during my tenure in the Fundamental Research Laboratories included the application of variable emissivity substance using the perovskite-manganese oxide materials that showed large resistivity change.

B: Fundamental Research Laboratories from 1995 to present. My responsibilities and tasks included the development of colossal magneto-resistance materials. The development during my tenure in the Fundamental Research Laboratories included the development of colossal magneto-resistance materials of the (La,Sr)MnO3 perovskites and the Tl2Mn2O7 pyrochlores that showed large resistivity changes under magnetic field.

C: Fundamental Research Laboratories from 1987 to present. My responsibilities and tasks included the development of electrical conducting materials. The

development during my tenure in the Fundamental Research Laboratories included the development of superconducting oxide materials and magneto-resistance oxide materials.

3. I hold many patents and have authored several papers in the field of my expertise. A partial list of these papers and patents are attached as an appendix.

4. My education, years of service in the field of heat control devices and systems, and recognition in the form of patents and publications establish me as an expert in the field of heat control devices and systems, qualified to provide evidence on the level of skill in the art and on what would be obvious to one of ordinary skill in the art.

5. A person of ordinary skill in the art would have an engineering degree and approximately 10 years of experience including the design of temperature control devices.

6. I have reviewed the patent application having Serial No. 09/198,376 and the Office Actions dated December 15, 1999 and June 28, 2000 as well as the Advisory Action dated October 10, 2000.

7. I have also reviewed the Examiner's applied references, including U.S. Patent No. 3,565,671 to Teeg et al., U.S. Patent 5,562,154 to Benson et al., U.S. Patent No. 5,608,414 to Amore and JP 1-212699 to Okamoto. I have also reviewed the paper authored by C. H. Neuman et al., Journal of Chemical Physics, Vol. 41, No. 6, 9/15/64 entitled Pressure Dependence of the Resistance of VO_2.

8. I am very familiar with the properties of VO_2 as described in the C. H. Neuman et al. paper. In my expert opinion, VO_2 has a negative temperature variance of emmisivity.

9. One of ordinary skill in the art would readily recognize that the H. Neuman et al. paper confirms that VO_2 has a positive temperature variance of conductivity with increasing temperature. In Figure 1 of the H. Neuman et al. paper temperature is plotted against conductivity for VO_2. Being even more specific, in Figure 1, a temperature dependency of the conductivity of a single crystal of VO_2 is shown. The x-axis of Figure 1 shows the thousand times of the reciprocal of temperature (1000/temperature) and the y-axis shows the conductivity. The x-axis thus shows an increase in temperature from right to left (i.e., the left side being high temperature and the right side being low temperature). As shown in Figure 1, conductivity for VO_2 is low at the right hand side (low temperature side) but is high at the left hand side (high temperature side) with respect to approximately 0.00294 (340K). These properties of VO_2 are well known in the art.

10. The invention described and claimed in U.S. Application Serial No. 09/198,376 utilizes a heat control device which is capable of efficiently and reliably working in many different extreme environmental conditions. The heat control device includes a variable phase substance which has a phase variation at room temperature. The substance comprises a perovskite Mn oxide of Mn-containing perovskite represented by $A_{1-x}B_xMnO_3$. The substance "A" may be La, Pr, Nd or Sm rare earth ions, and the substance "B" may be Ca, Sr and Ba alkaline rare earth ions. The variable phase substance may also be oxide of Cr-containing corundum vanadium or a variable-phase substance comprising $(V_{1-x},Cr_x)_2O_3$.

11. It is my expert opinion that the substances noted in paragraph 10 exhibit emissivity characteristics of an insulator at a relatively high temperature and emissivity characteristics of a metal at a relatively low temperature. Thus, the claimed substances of U.S. Application Serial No. 09/198,376 exhibit a relatively low emissivity at the relatively low temperature and a relatively high emissivity at the relatively high temperature. The substances of the claimed invention thus exhibit a positive temperature variance (e.g., conductivity decreases due to temperature elevation) of emissivity with increasing temperature, owing to the material characteristics of negative variance of conductivity with increasing temperature.

12. By using the substances noted in paragraph 10, it is also my opinion as would be the opinion of one of ordinary skill in the art that the phase transition temperature may be variable between the temperature ranges of 250 K and 350 K in accordance with the composition ratio of "x" of La and Sr. Also, by using the substance of the present invention, reflectivity around photon energy 0.12 eV decreases between 170 K to 380 K, with increasing temperature. Taking all of these properties into account, the substances disclosed and claimed in U.S. Application Serial No. 09/198,376 provide superior phase transition properties, which are capable of increasing the longevity of objects such as, for example, spacecraft, by protecting such spacecraft from the extreme temperatures encountered in space.

13. A novelty of the claimed invention is the discovery that the substance to which the present invention pertains is extremely rare in that this substance has a transition point around normal temperature and has conductivity which is low at high temperature side but high at a low temperature side. The substances of the claimed invention thus have negative temperature variance of conductivity with increasing temperature. One of ordinary skill would recognize that this is completely opposite to the properties of VO_2 described and shown in Figure 1 of the H. Neuman et al. paper. This is also contrary to the Examiner's position set forth in the many office actions and Advisory Action.

14. After carefully reviewing the Benson reference (U.S. Patent 5,562,154), it is my expert opinion that the Benson reference does not properly and accurately disclose the properties of vandium oxide (VO_2). That is, the Benson reference incorrectly noted that VO_2 has a negative temperature variance of conductivity with increasing temperature. In fact, after reading col. 13,

lines 18-28 of the Benson reference, I am convinced and one of ordinary skill in the art would appreciate that the Benson reference clearly misunderstands that VO_2 actually has positive temperature variance of conductivity with increasing temperature, i.e., conductive at high temperature and insulative at low temperature. It is also my expert opinion, that the use of VO_2 is not practical in the manner as suggested in the Benson reference.

15. In view of the above, I would thus not rely on the Benson reference for the proposition of a substance having a negative temperature variance of conductivity with increasing temperature.

16. The Okamoto reference also discloses the use VO_2. The Okamoto reference clearly and accurately discloses that VO_2 has a positive temperature variance of conductivity with increasing temperature.

17. In view of the above comments, it is my opinion that the Examiner has misunderstood the properties of VO_2. It is my further opinion that the claimed invention is not obvious in view of the applied references. That is, it would not have been obvious to one of ordinary skill in the art at the time the invention was made to have a substance, as claimed, with a positive temperature variance (e.g., increased emmisivity due to temperature elevation), owing to the material characteristics of negative temperature variance of conductivity with increasing temperature.

18. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above-referenced application and any patent issuing thereon.

Date 6/12/2001 Yoshimi Kubo

APPENDIX

A partial list of my papers and patents

Papers

1. Y. Kubo, Y. Shimakawa, T. Manako, and H. Igarashi, "Transport and magnetic properties of $Tl_2Ba_2CuO_{6+\delta}$ showing a δ-dependent gradual transition from a 85-K superconductor to a nonsuperconducting metal", **Phys. Rev. B 43**, 7875 (1991).

2. Y. Kubo, T. Kondo, Y. Shimakawa, T. Manako, and H. Igarashi, "Superconductor-to-metal transition caused by oxygen nonstoichiometry in $TlSr_2CaCu_2O_{7-\delta}$ having a Cu-O pyramidal layer", **Phys. Rev. B 45**, 5553 (1992).

3. Y. Shimakawa, Y. Kubo, and T. Manako, "Giant Magnetoresistance in $Tl_2Mn_2O_7$ with the pyrochlore structure", **Nature 379**, 6560 (1996).

4. T. Obata, T. Manako, Y. Shimakawa, and Y. Kubo, "Tunneling magnetoresistance at up to 270K in $La_{0.8}Sr_{0.2}MnO_3/SrTiO_3$ /$La_{0.8}Sr_{0.2}MnO_3$ Junctions with 1.6-nm-Thick Barriers", **Appl. Phys. Lett. 74**, 290 (1999).

5. H. Imai, Y. Shimakawa, Yu. V. Sushko, and Y. Kubo, "Carrier density change in the colossal-magnetoresistance pyrochlore $Tl_2Mn_2O_7$ ", **Phys. Rev. B 62**, 12190 (2000).

Patents

1. T. Manako, Y. Shimakawa, and Y. Kubo, " OXIDE SUPERCONDUCTOR COMPOSITION AND A PROCESS FOR THE PRODUCTION THEREOF" European Patent 0,362,685 (1993).

2. T. Manako, Y. Shimakawa, and Y. Kubo, " OXIDE SUPERCONDUCTOR COMPOSITION AND A PROCESS FOR THE PRODUCTION THEREOF" US Patent 5,328,892 (1994).

3. Y. Shimakawa, Y. Kubo, and T. Manako, " COMPOUND MAGNETORESISTIVE MATERIAL AND METHOD FOR PREPARING THE SAME" US Patent 5,759,434 (1998).